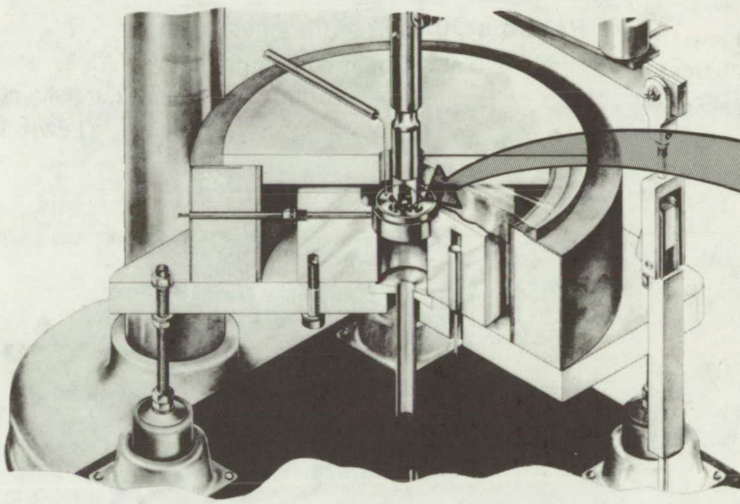
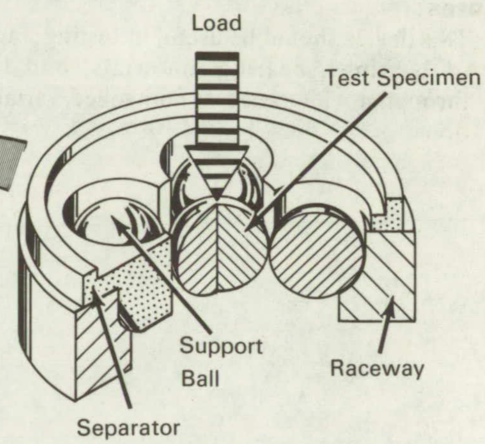
NASA TECH BRIEF

Tester for Study of Rolling Element Bearings





The problem:

To design a test device for the study of rolling element phenomena including rolling-element (bearing) fatigue, ball-bearing kinematics and elastohydrodynamic lubrication at temperatures from $-300°$ to $2000°$F.

The solution:

A five-ball fatigue tester consisting essentially of a driven test ball pyramided upon four lower balls positioned by a separator and free to rotate in an angular contact raceway. With each revolution of the drive shaft, the upper ball receives three stress cycles. The upper test ball and the raceway are analogous in operation to the inner and outer races, respectively, of a bearing. The separator and the lower balls function in a manner similar to the cage and the balls of a bearing.

How it's done:

The test specimen assembly comprises the upper test ball specimen pyramided upon the four lower test ball specimens which are positioned in the angular contact raceway by the separator. Specimen loading and drive is supplied through a vertical shaft. By varying the pitch diameter of the four lower balls, bearing contact angle may be controlled.

The test specimen assembly is fitted in a housing containing a plurality of cartridge type heaters for obtaining test temperatures to 1000°F. The housing is supported by rods held in flexible rubber mounts. The rods provide for alignment of the raceway and four lower balls with the upper test ball and drive shaft, and the flexible rubber mounts dampen vertical oscillations of the drive shaft created by vibration. Such vibrations, if not dampened, will increase the stress

(continued overleaf)

level of the ball specimen, thus influencing fatigue-life results.

Choice of test-specimen rotative speed is provided through step pulleys driven by an electric motor. A magnetic pickup feeding an electronic counter provides for precise speed measurement. Ambient temperature is measured with a thermocouple in contact with the raceway containing the freely rotating lower balls. The test specimen is lubricated by metering droplets of fluid lubricants into an air stream directed at the test specimen.

Modifications of this apparatus have been made permitting fatigue testing at temperatures ranging from −300° to 2000°F, and testing of full scale bearings. The use of a failure detection and shutdown system have made long term unmonitored tests possible.

Notes:

1. This device should be useful in testing and research of bearings, bearing materials, and lubricants through a wide range of controlled variable conditions.
2. Additional information concerning this innovation is given in NASA TN D-259, "Rolling-Contact Fatigue Life of a Crystallized Glass Ceramic," by Thomas L. Carter and Erwin V. Zaretsky, and NASA TN D-270, "Effect of Hardness and Other Mechanical properties on Rolling-Contact Fatigue Life of Four High Temperature Bearing Steels," by Thomas L. Carter, Erwin V. Zaretsky and William J. Anderson, available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151. Inquiries may also be directed to:

    Technology Utilization Officer
    Lewis Research Center
    21000 Brookpark Road
    Cleveland, Ohio 44135
    Reference B67-10009

Patent status:

No patent action is contemplated by NASA.

Source: Erwin V. Zaretsky et al.
(Lewis-305)